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tech tips

Understanding The TVA92 Horizontal Output Load Test

Many problems involving the horizontal output stage are difficult to troubleshoot. Problems in the horizontal output stage may cause startup or shutdown symptoms, or may instantly destroy replacement output transistors or power supply components. Since these conditions occur only momentarily, normal troubleshooting measurements and procedures with the chassis running are impossible.

This Tech Tip explains how to use the TVA92's Horizontal Output Load Test to check the horizontal output stage with the chassis off. It explains how the test works, how to perform the test and how to interpret the results. Tech Tip #211, "Troubleshooting Using The TVA92's Horizontal Output Load Test" explains how to use the results of the Load Test to help isolate the defective component.

Why Use The Horizontal Load Test?

A severe load or timing problem in the horizontal output stage places an immediate, high current stress on the B+ power supply and output components when the chassis is turned on. This often results in immediate damage to the replacement horizontal output transistor and/or B+ power supply components.

The horizontal output stage and B+ power supply closely depend on each other for proper operation. The output stage needs a well filtered and well regulated voltage, but the B+ power supply can only provide well regulated and filtered voltage as long as the current demand from the output stage is within a normal range. This makes it difficult to determine if a low B+ voltage symptom, for example, is caused by a defect in the power supply, or if the horizontal output stage is demanding higher than normal current.

The startup and shutdown loops tie closely to the horizontal output stage. A problem in the output stage may prevent the chassis from starting, even when the startup circuits are good. Abnormal conditions in the output stage or B+ regulator may cause immediate shutdown. But, since these conditions occur momentarily, conventional voltage measurements cannot be made.

Many chassis use a switch mode power supply (SMPS) as the B+ supply. A popular shutdown method in these chassis is to defeat the SMPS when excessive high voltage is detected. This of course removes the B+ voltage from the output stage, making it difficult to determine whether the problems is in the B+ supply, the horizontal output stage or in the safety shutdown circuits. A further complication is that most SMPS do not allow you to reduce the B+ voltage by lowering the AC line voltage. This prevents you from analyzing the horizontal output stage at a reduced voltage.

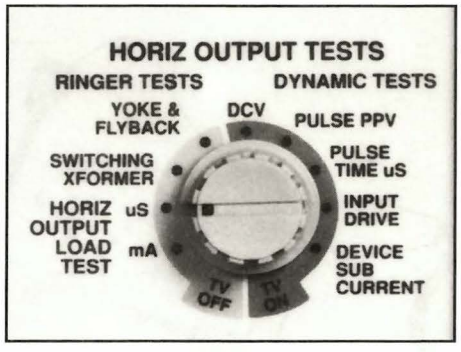

Fig. 1 - Use the Horizontal Output Load Tests to analyze the condition of the horizontal output stage before applying power to the chassis.

How The Horizontal Output Load Test Works

The Horizontal Output Load Test allows you to detect severe loading and timing problems in the horizontal output stage before you apply AC power to the chassis, as shown in Figure 1. This enables you to analyze the operation of the output stage, no matter what the symptom, so you can quickly determine if it is causing B+ supply loading (Low B+), improper startup, safety shutdown or some other problem.

For any horizontal output circuit to operate it requires three things:

1. B+ voltage to the primary of the flyback transformer.
2. A switch (transistor) that completes the current path from the flyback primary to ground.
3. A drive signal to turns the switching transistor on and off at a 15.734 kHz rate with an on time of approximately 30 µS.

The TVA92's Horizontal Output Load Test satisfies these basic requirements. It supplies a low level B+ voltage to the output stage and simulates the switching action of the chassis horizontal output transistor. Figure 2 shows the TVA92's internal Horizontal Output Load Test circuit blocks and key components.

The Horizontal Output Load Test energizes the chassis horizontal output stage. If the horizontal output stage is good, the Load Test accurately simulates the horizontal output stage's operating conditions. Flyback, yoke, and secondary load currents are produced, just as they would be if the chassis was operating at full potentials. Flyback pulses are also

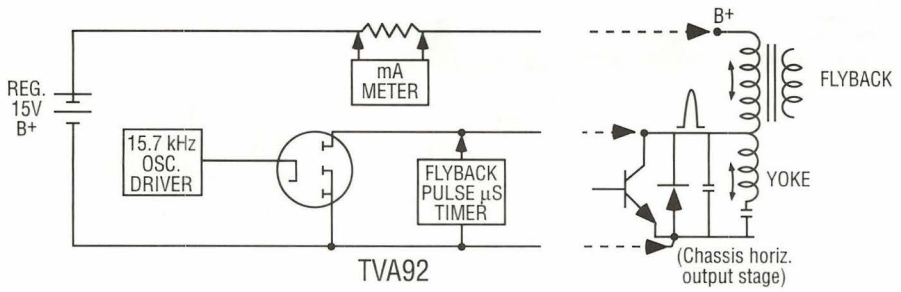

Fig. 2 - The Horizontal Output Load Test applies a low B+ voltage and switching action to simulate the horizontal output's operating conditions.

produced which reflect the critical timing of the resonant circuits.

The TVA92 monitors the horizontal output stage during the Horizontal Output Load Test. The "µS" Load Test measures the duration of the flyback pulse, while the "mA" test measures the current supplied by the 15 volt B+ supply to the output stage. In a normally operating output stage good flyback pulse time and a normal range of current will be indicated by the Load Test. But, if the output stage has severe problems, abnormal flyback pulse time or current will be measured during the Horizontal Output Load Test.

Performing The Horizontal Output Load Test

To test the horizontal output stage with the Horizontal Output Load Test you must make 3 connections to the chassis: 1) B+ side of flyback primary; 2) collector of horizontal output transistor; and 3) emitter of horizontal output transistor, as shown in Figure 3. The clips on the RINGER/LOAD TEST LEAD are labeled and color coded for easy identification as follows:

orange / B+ = B+ side of flyback
yellow / C = collector of HOT
black / E = emitter of HOT

If the HORIZ OUTPUT TESTS Readout shows dashed lines when one of the Horiz Output Load Tests is selected, the TVA92 is not receiving flyback pulses or delivering current to the output stage. Check to make sure you are connected to the proper test points.

The Horizontal Output Load Tests are performed with AC power to the chassis removed. The TVA92 contains internal protection circuitry, but to remove any chance of damaging either the analyzer or the chassis always unplug the AC line cord to the chassis before connecting the test leads.

CAUTION

Only perform the HORIZ OUTPUT LOAD TEST with the AC power to the chassis removed. Remove AC power by unplugging the AC line cord.

Note: The Horizontal Output Load Test may be performed with the chassis horizontal output transistor in circuit, unless the transistor is shorted. If the chassis horizontal output transistor is shorted it must be removed.

To perform the Horiz Output Load Test:

1. Unplug the AC cord to the chassis.
2. Connect RINGER/LOAD TEST LEADS to the proper circuit points.
3. Set the HORIZONTAL OUTPUT TESTS Switch to Horiz Output Load Test "mA".
4. Read the results in the HORIZ OUTPUT TESTS Display.
5. Set the HORIZONTAL OUTPUT TESTS Switch to Horiz Output Load Test "µS".
6. Read the results in the HORIZ OUTPUT TESTS Display.

CAUTION

The Horiz Output Load Test produces flyback voltage pulses at the collector of the chassis horizontal output transistor and the flyback transformer secondaries. Do not come in contact with these energized circuit points during the load test.

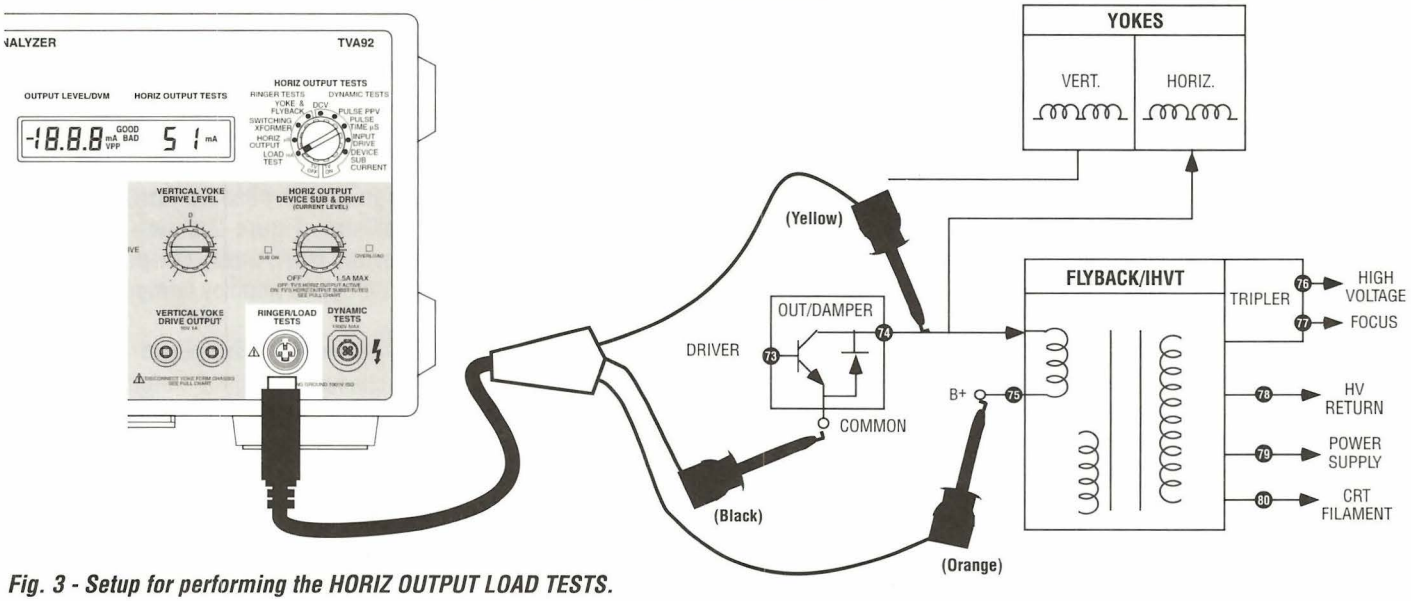

Fig. 3 - Setup for performing the HORIZ OUTPUT LOAD TESTS.

Interpreting The mA and µS Readings

The HORIZ OUTPUT TESTS Readout displays the two parameters that most accurately reflect the operation of the horizontal output stage under test. These parameters indicate if the horizontal output stage has a severe problem which will cause B+ supply loading, startup, shutdown or other problems. Each test includes a numerical reading as well as a "Good/Bad" indication. Table 1 summarizes the Good/Bad ranges for each test.

mA - The mA reading is the amount of B+ current drawn from the TVA92's 15 volt power supply. Readings between 5 to 80 mA represent a normal range of current and are considered "GOOD". Current levels less than 5 mA usually indicate an invalid test condition, such as improper test lead connections, or an open in the horizontal output circuit. Current readings greater than 80 mA are "BAD" and indicate a heavy load in the horizontal output or flyback circuitry that will likely load down the power supply.

µS - The µS readout indicates the time duration (also called pulse width or retrace time) of the flyback pulse generated during the Load Test. This pulse time is set by the chassis horizontal output circuits, primarily the flyback, retrace timing capacitors, yoke and yoke capacitor. Therefore it is nearly identical to what the time would be if the chassis was powered up at full AC voltage.

The pulse time indicates if proper timing and resonant action is occurring in the flyback and yoke circuits. Readings between 11.3 and 15.9 µS represent a normal range of pulse widths and are considered "GOOD". Readings outside this range are "BAD" and indicate improper timing, flyback defects or severe loading problems.

The normal "Good/Bad" ranges shown in Table 1 take into account a wide variety of horizontal output stages. If a particular horizontal output stage reads "Good" in both Load Tests, you may be certain that the horizontal output stage and flyback secondaries are not an immediate threat to a replacement output transistor or to the chassis B+ power supply when you apply full AC power. You also know that the output stage is not the cause of a startup or shutdown condition.

Usually a "Good" reading for both Load Tests indicates that the horizontal output circuit is 100% problem free. However, some minor leakage paths in the output stage or a secondary load may not drastically change the circuit's parameters. In these rare cases, the Horizontal Output Load Tests may not be altered significantly and will remain in the "Good" range. When these problems occur the output stage may be thoroughly analyzed with AC power applied to the chassis using the TVA92's Dynamic Tests.

A "Bad" reading in one or both of the Horizontal Output Load Tests indicates a problem in the horizontal output circuit, flyback or flyback secondary. Use the "Bad" readout to help determine what to look for when isolating the problem. Table 2 outlines some of the likely causes for different combinations of Load Test results.

Some horizontal output circuit problems will cause the "µS" readings to fluctuate between "Good" and "Bad" values during the test. Fluctuating pulse time readings indicate multiple flyback pulses or severe flyback pulse ringing. In either case, an abnormal loading or timing problem is indicated that needs to be corrected.

Refer to Tech Tip #211, "Troubleshooting Using The TVA92's Horizontal Output Load Test" for more information on how to use the results of the Load Tests to help isolate the defective component.

TEST:	Normal Range	Bad Range
mA	5 - 80 mA	<5 mA or >80 mA
µS	11.3 - 15.9 µS	<11.3 µs or >16.9 µS

Table 1 - Horiz Output Load Test Good/Bad Ranges.

HORIZ LOAD TEST READOUTS mA	µS	MOST LIKELY CAUSES
- - -	- - -	• Improper Connections • Open Flyback • Open Output Stage Circuit Paths
BAD	- - -	• Severe B+ Supply Short Or Leakage Path • < 5 mA = Open Flyback Or Circuit Path
GOOD	- - -	• Open Flyback • Improper "Collector" Connection • Open Ringer/Load Fuse
GOOD	GOOD	• No Severe Loading Or Timing Defects
BAD	GOOD	• Severe B+ Leakage And/Or Flyback Secondary Short Or Leakage Path • Flyback Transformer
GOOD	BAD	• Defective Output Timing Components • Flyback Transformer • Severe Flyback Secondary Short Or Leakage Path
BAD	BAD	• Severe B+ Leakage • Flyback Secondary Short Or Leakage Path • Flyback Transformer • Defective Output Timing Components

NOTE: Fluctuating µS readout values indicate abnormal flyback pulse ringing or timing.

Table 2- Possible Horizontal Output Load Test readings and likely causes.

Chassis Having A B+ Less Than 100VDC

The "Good"/"Bad" mA range is established for horizontal output stages that have normal B+ voltages ranging from 100-160 volts. A few older color television receiver have B+ supply voltages less than 100 volts. These receivers will normally draw higher than the 80 mA "Bad" limit when tested with the Load Test. To test these receivers, compare current readings to those measured in a known working model of the same type.

If a working model is not available, disconnect the orange B+ lead of the Ringer/Load Test and use the TVA92's DC Bias Supply to apply a DC voltage that is 1/10 the value of the TV's normal B+ voltage. (Connect the voltage between the B+ side of the flyback transformer and ground, leaving the orange B+ Ringer Test Lead disconnected). Measure the DC Bias Supply current with the Output Signal Monitor/DVM while performing the Horizontal Output Load Test. If the output stage is good, the current reading should be less than 80 mA.

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